

# **Confectionary sunflower**

## **A new breeding program**

**Sun Yue (Jenny)**



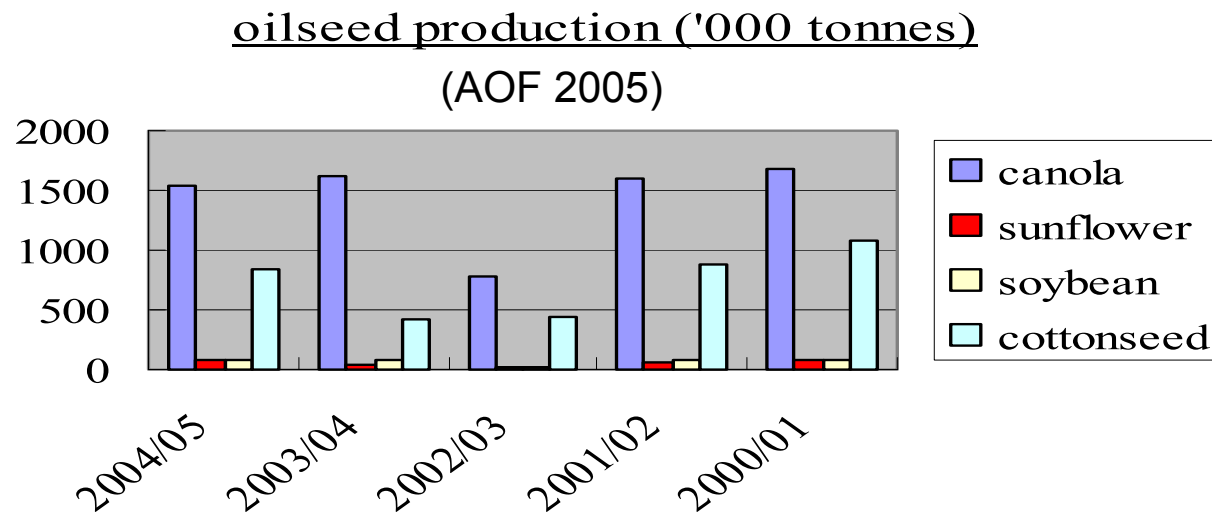
## ◆ Sunflower in Australia

**Oilseed:** vegetable oil, margarine

Canola, cotton seeds account for >90% of oilseed production



**Sunflower less competitive  
(poor reliability of supply)**



## ◆ Sunflower in Australia

**Non –oilseed** (accounts for <10% of sunflower production)

Birdfeed, stock feed, confectionary for human consumption

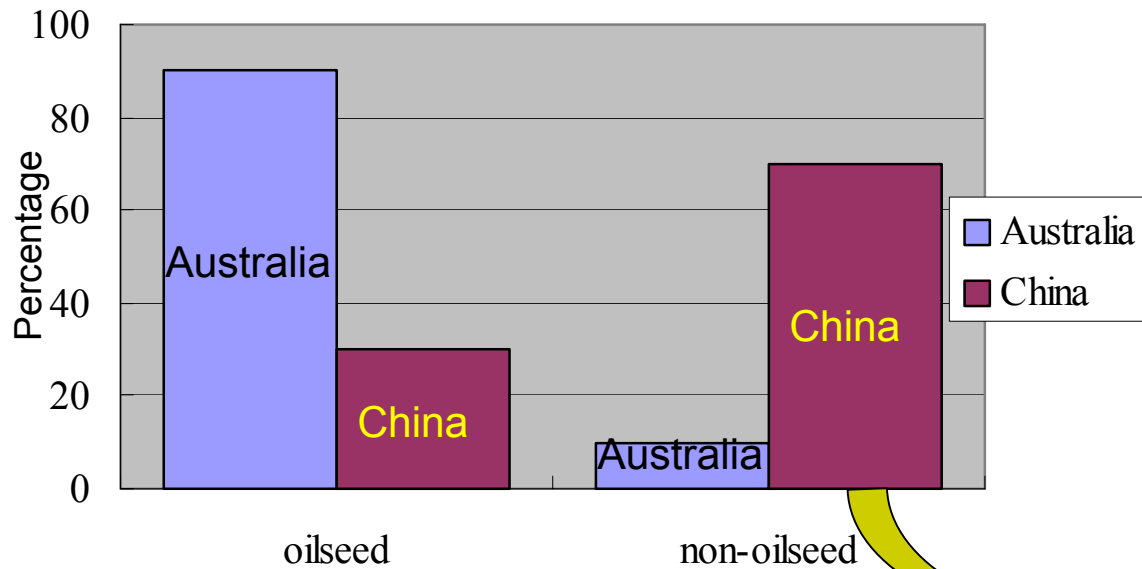


**Limited domestic market**

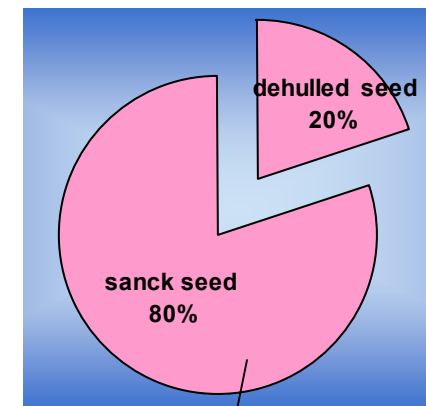


## ◆ Chinese market for snack sunflower

Australia and Chinese sunflower industry comparison



Chinese non-oilseed sunflower



In 2002, Chinese snack sunflower production was **800.000 tonnes**

Year	2002	2003	2004	2005
Australian Sunflower production (tonne)	<b>70,000</b>	<b>25,000</b>	<b>58,000</b>	<b>69,000</b>

(FAO Stat 2006)

## ◆ Chinese market for snack sunflower

In China, sunflower seeds are the most popular snack



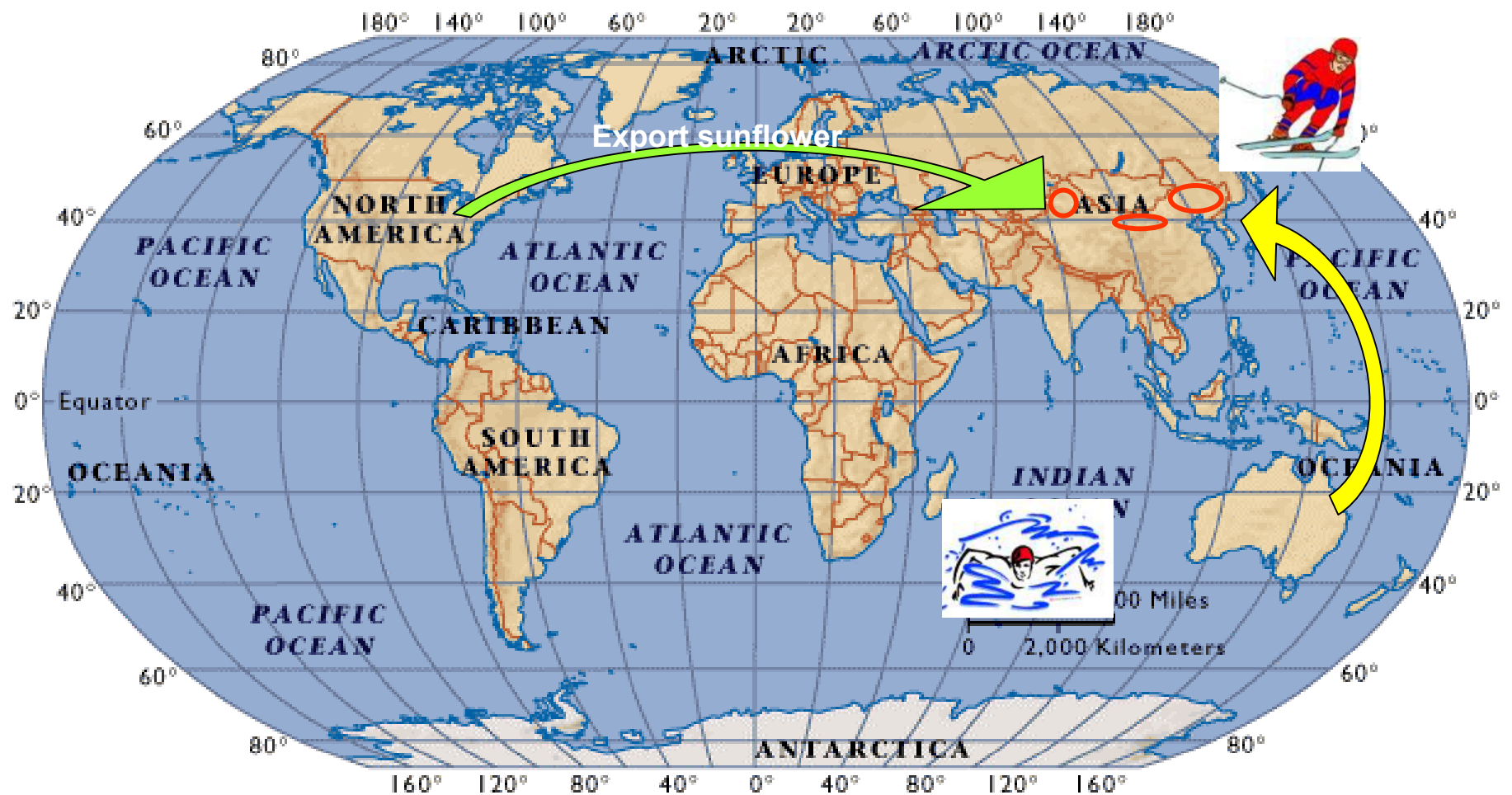
## ◆ Chinese market for snack sunflower

Snack sunflower seeds can be purchased everywhere in China



## ◆ Opportunity for Australia

In China, during winter off-season, there is a short-fall of supply



## ◆ Opportunity for Australia

### Challenge

#### ▶ Seed length

Chinese market requires seed > 20 mm



**Chinese snack sunflower seeds**

**~30 mm**

**HA89 Hysun 33**

**9~10mm**

## ◆ Opportunity for Australia

### Challenge

#### ▶ Seed length

#### ▶ Improve available large seed germplasm

Current large seed sunflower germplasm usually have:

- Low **transpiration efficiency**
- Rust susceptible
- Low self compatibility
- Poor adaptation to Australian environments

#### High transpiration efficiency

For irrigated crops → reduce water needed

For dry land crops → increase drought tolerance



## ◆ Project outline

- **Objective**

Breed new confectionary sunflower germplasm

- **Project plan**

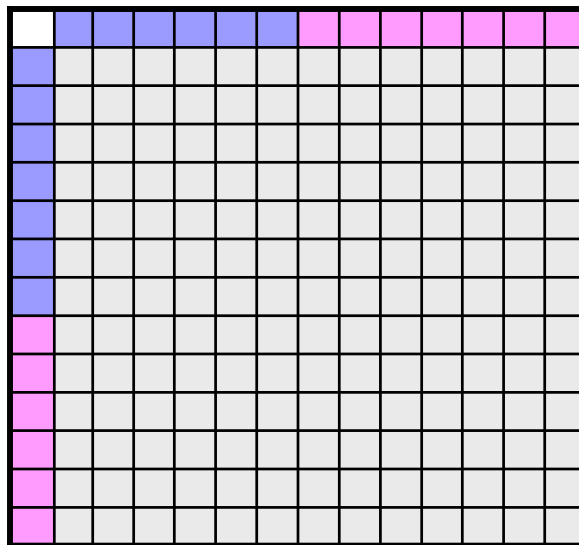
- Understand the inheritance of seed length and environment effect  
(eg. Temperature )
- QTL analysis of seed length and other target traits
- Breed A, B and R-lines for making confectionary sunflower hybrids




## ◆ Breeding new confectionary sunflower germplasm

### ▶ Genetics inheritance of seed length

#### ▶ Diallel crossing strategy



 Large seed sunflower lines  
16~23 mm

 Small seed sunflower lines  
9~11 mm

Analysis of F1 seed length



Preliminary estimate of dominance effect

Existence of heterosis

## ◆ Breeding new confectionary sunflower germplasm

### ▶ Genetics inheritance of seed length

### ▶ Analysis of F1 seed length

#### General Combining Ability (GCA)

-- average performance of a line in hybrid combination

additive effect

#### Specific Combining Ability (SCA)

-- better or worse performance in certain combinations based on GCA of lines involved

additive effect

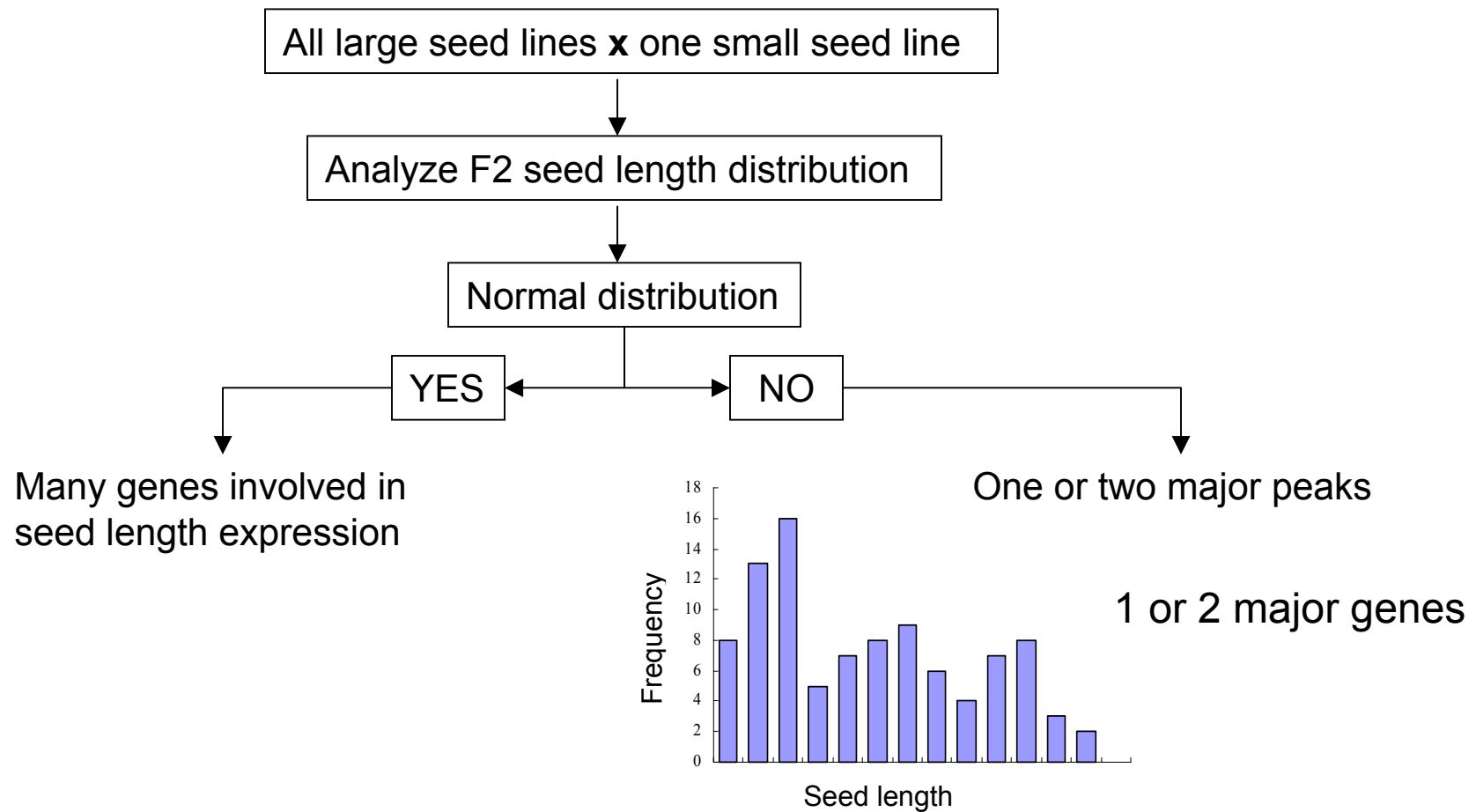
Griffing's model I (fixed lines) :

$$X_{ij} = u_0 + g_i + g_j + s_{ij} + r_{ij} + e_{ijk}$$

## ◆ Breeding new confectionary sunflower germplasm

### ▶ Genetics inheritance of seed length

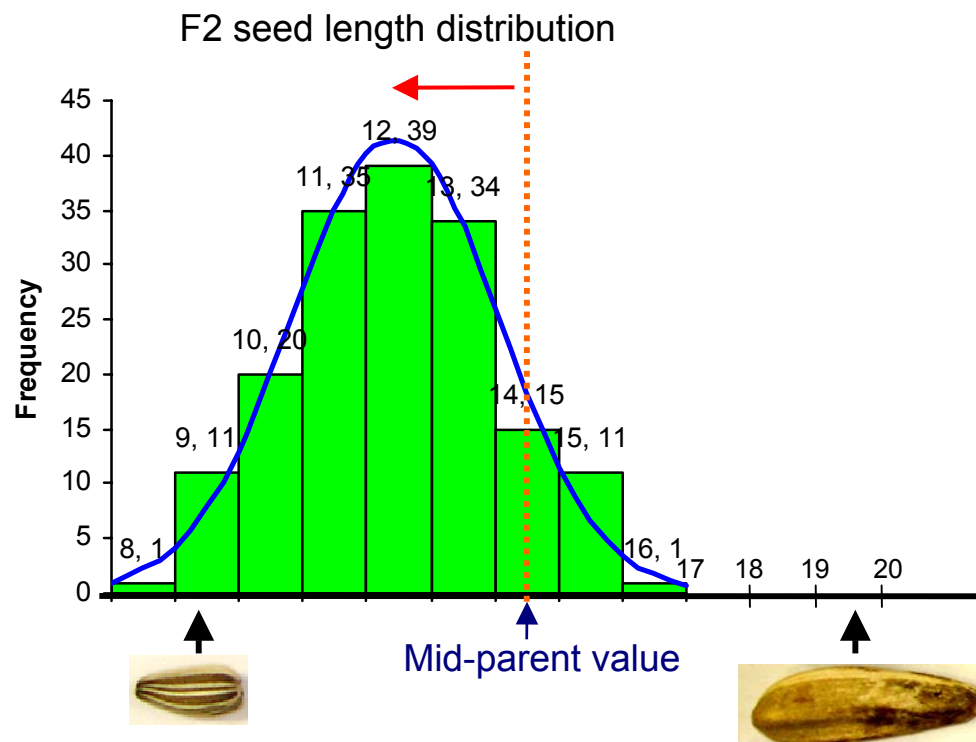
#### ▶ Analysis of F2 seed length



## ◆ Breeding new confectionary sunflower germplasm

### ▶ Genetic inheritance of seed length

### ▶ Analysis of F2 seed length

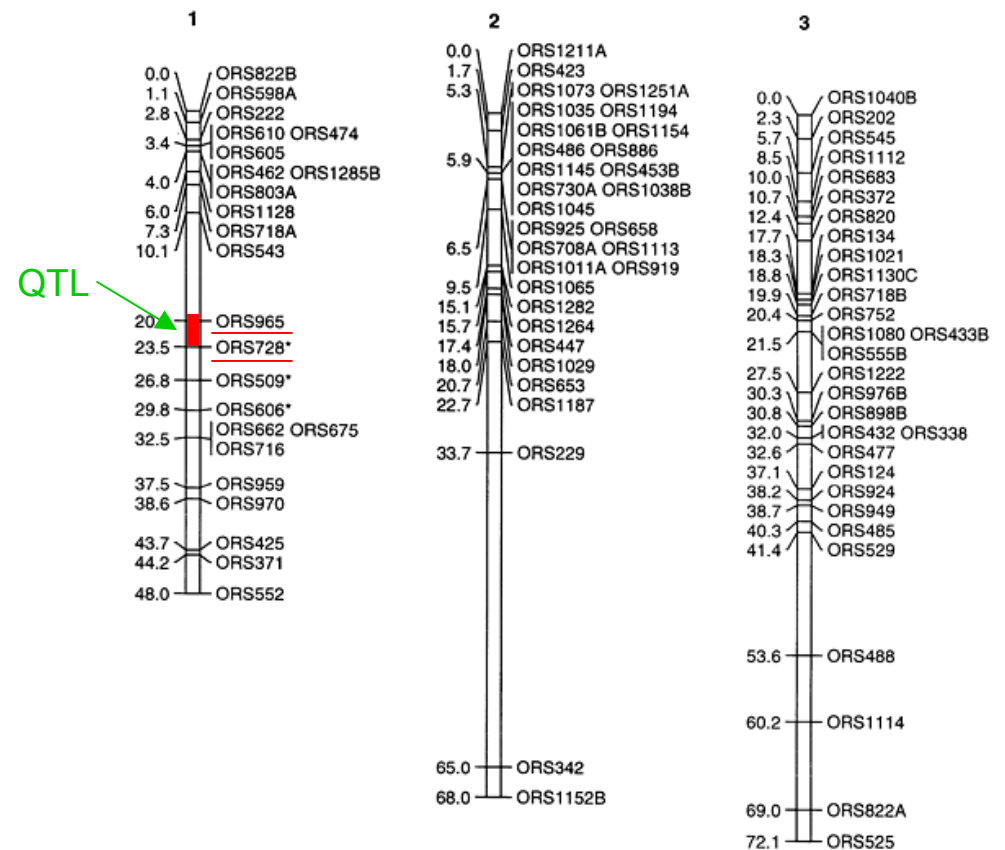
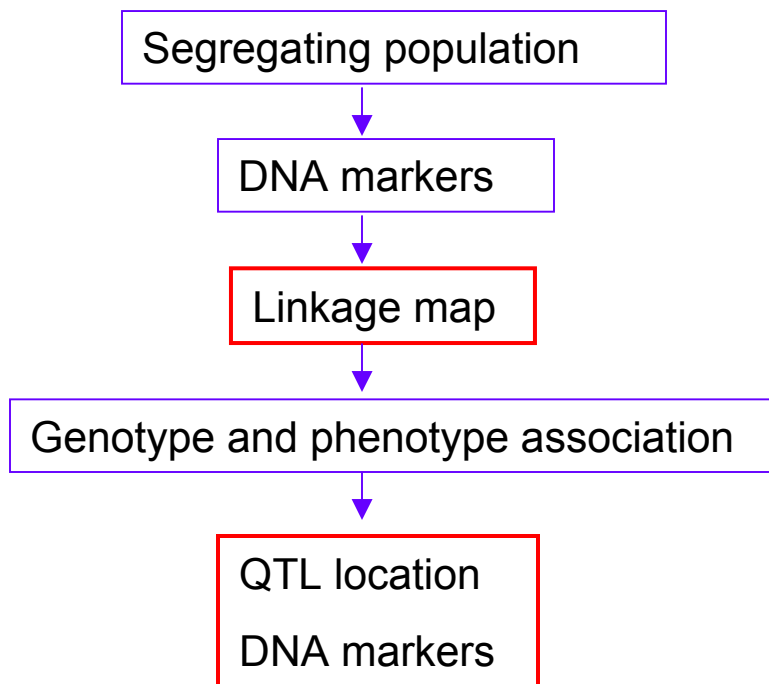


- Normal distribution  
→ Polygenic system
- Skew towards small seed  
→ large seed recessive

## ◆ Breeding new confectionary sunflower germplasm

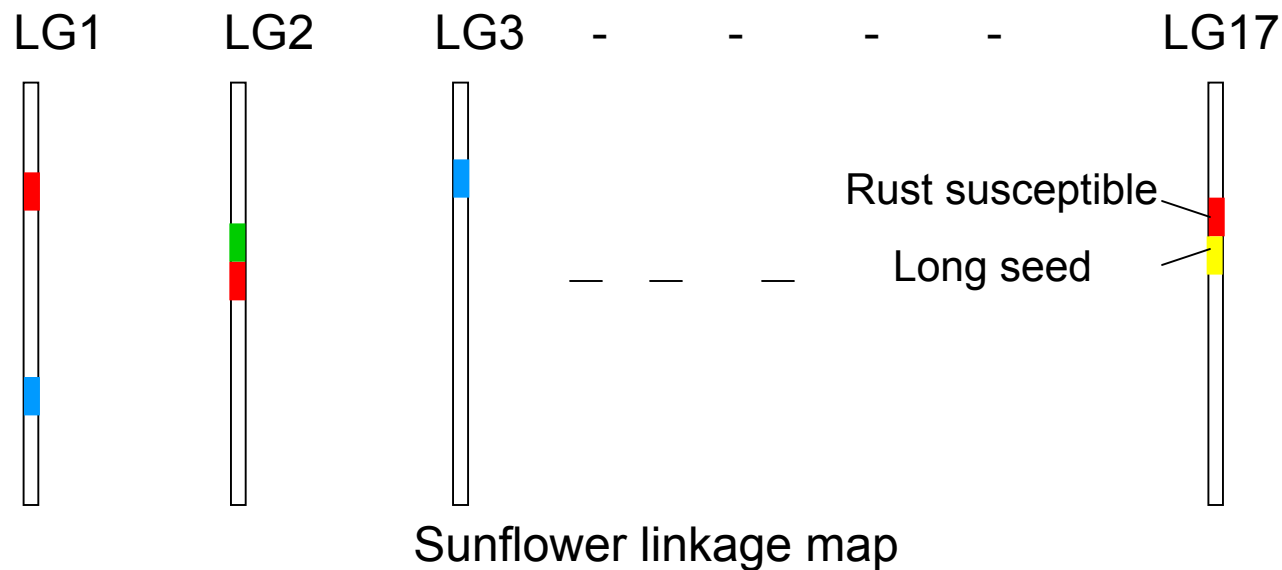
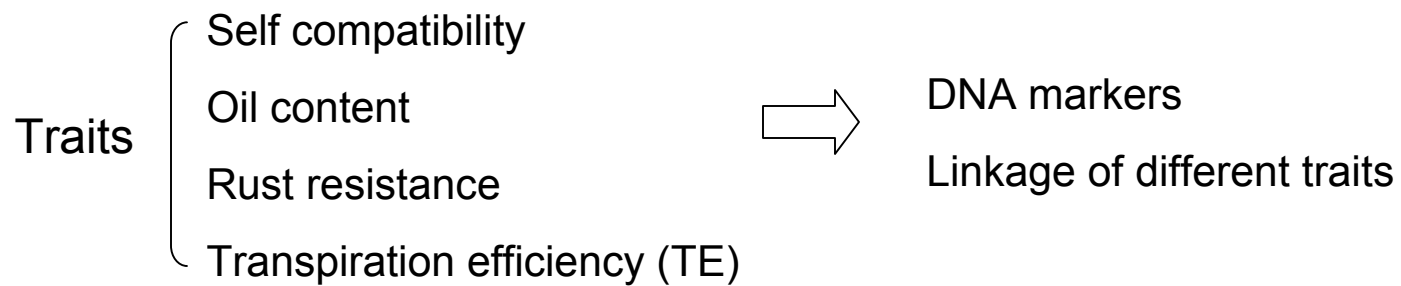
### ▶ QTL analysis of seed length

- Discover the number of **genomic regions** controlling seed length
- Identify **DNA markers** closed linked to these regions



## ◆ Breeding new confectionary sunflower germplasm

### ▶ QTL analysis and association with other traits



## ◆ Breeding new confectionary sunflower germplasm

### ▶ Genetic inheritance of seed length

⇒ Average gene action of seed length  
Best lines for breeding program

### ▶ QTL analysis of target traits

⇒ The number of genomic regions controlling target traits  
DNA markers useful as selection markers in breeding process

## ◆ Breeding new confectionary sunflower germplasm

### ▶ Sources of favorable traits



High transpiration efficiency:

- UQ materials developed in previous GRDC project.



Rust resistance, high self compatibility

- UQ materials + various sources

## ◆ Breeding new confectionary sunflower germplasm

### ▶ Breeding process

Breeding A, B and R-lines, and incorporate the following favorable traits:

- large seed length
- high transpiration efficiency
- rust resistant
- high self compatibility

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